Potato futures: impact of hybrid varieties

Report of an online conference held on November 30 2020 in Doorn the Netherlands.

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Preface

This report describes the proceedings, discussion items and opinions about the impact of hybrid potato, expressed during a one day conference on November 30th, 2020. The main emphasis is on the industrialised world with Europe as an example and on lower income economies with Africa as an example. The speakers represented various stakeholders from private industries, universities and research centres, donor organisations, non-governmental organisations and policy makers. There was a common understanding that hybrid potato has great potential for future food security on a global scale, but the impact on potato systems may be regarded as a paradigm shift and will require major adjustments of existing potato systems. The joint and collaborate efforts of all partners in these systems is required for a successful implementation. This report describes the subjects presented and discussed at the conference in great detail. To help the reader, key messages are described at the start of each section.

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Key messages

Diploid hybrid potato as a system innovation

- Hybrid potato breeding is a system innovation which may affect almost every step in the potato value chain. It can thus be seen as a disruptive and game changing technology, involving and affecting all players in the sector.
- Potato breeding and cultivation will more and more follow the dynamics of the vegetable sector, characterized by the rapid introduction of new varieties, product diversification, higher nutritional value and the introduction of resistant and stress-tolerant cultivars.
- For a further understanding of the impact of hybrid potato, we must distinguish between the value chain in high income and low income countries as different system contexts.

The future of hybrid potato: an agenda for debate

- Hybrid potato seed may play a crucial role in the development of global and regional agri-food systems and consequently may strongly affect potato tuber cultivation and industry in the Netherlands.
- The question how to combine business opportunities for breeders with variety development that serves global food security in sustainable ways is one of the main challenges in hybrid potato innovation.
- One of the most challenging problems in Africa is that farmers often keep inferior tubers as planting material instead of tubers with the highest quality. A successful introduction of hybrid potato will therefore require specialized seed potato growers who can produce and multiply certified potato planting material.

Opportunities and threats of hybrid potato for the Dutch agro-industrial potato sector

- The involvement with every aspect of the potato value chain – breeding, cultivation, trade, processing, logistics and technology – makes the Netherlands a vibrant centre in the potato world.
- Hybrid breeding and hybrid potato seed are important innovations for the sector because it may open new markets, especially in regions that are difficult to reach with the export of seed potatoes.
- Although the market potential in Africa is still unclear, high-quality potatoes are crucial to help reach the SDG2 food security goals.
- For Africa, however, we do need business willing to invest in producing true hybrid potato seed, may be as part of corporate social responsibility. Alternatively the public sector could take up the challenge, although it generally has no convincing track-record in seed dissemination.
- It is way too early to predict whether there are opportunities for the Netherlands to become a main exporter of hybrid potato seed, as the final determinant for success is the hybrid potato business model.
- There is no reason to believe that in the international development context the informal seed potato market will disappear through legislation and IP. It will remain highly important for a long time to come.

Implications for (inter)national policy and regulation: round table discussion

- Although current regulations are designed for seed potato tubers, no legislative hurdles are to be expected when hybrid seed will enter the market, only requiring minor adjustments of the current international UPOV regime for the protection of new varieties of plants.
- There is much to win by strengthening informal seed systems and making regulation more inclusive, rather than just reinforcing established UPOV rules.

- We need to engage farmers in participatory plant breeding, especially in cases where public breeding is marginal and breeding companies are not interested in the informal market segment.

Challenges and opportunities for the introduction of hybrid potato in an African and international development context

- Potato as a vitally important crop to food security in Africa in the context of rapid population growth and urbanization, but we missed opportunities for increasing yields and farmer income.
- We have to look at innovations as packages, thus asking ourselves what would be the component innovations of a hybrid seed innovation package and how to deal with context specificities and bottlenecks in ways that smallholders can benefit.
- The biggest bottleneck for a widespread scaling of hybrid potato seed is the intermediate infrastructure that you need, including a network of nurseries with the capacity to raise plantlets from seeds, and competent producers of first generation tubers.
- Dialogue and collaboration, involving the whole sector 'diamond', is crucial to see how to make innovation fit and to create both 'push' and 'pull'.
- A working system of plant variety protection is a crucial condition for seed companies to become active in countries and introduce high value varieties.
- Seed certification is important for producers, but often will be too expensive for farmers to afford.

Key requirements for successful introduction of hybrid potato in Africa: experiences from the ground

- Seeing is believing: we should make farmers understand the added value of hybrid quality seed through mutual learning in farmer field trials.
- It is all important to clearly and timely inform potato farmers about the necessary changes in their farming practices when shifting from seed tubers to hybrid seed.
- Current variety development does not focus on the particular needs of African potato systems and there seems to be little interest from the international seed potato industry to invest in African countries.
- Even though farmers will keep to reusing commercially obtained potato planting material, there is plenty of room for market extension because only a very small percentage of farmers nowadays have access to quality seed.

Panel discussion

- Without denying the importance of plant breeders rights, research done with public funds should reflect the public good of affordable planting material.
- The interface between formal and informal seed systems requires flexible regulation, novel methods for access to seed and attention for the role of women as seed potato producers.
- Hybrid breeding offers the opportunity to focus on traits specifically needed in Africa, also enabling potato cultivation in new environments and warmer climate zones.

Closing reflections by Louise Fresco

- Undernutrition requires food that is affordable for the urban poor while offering income for the rural poor. This is only possible with an efficient organization of the food chain as a whole.
- The introduction of hybrid seed requires an integrated chain approach and coordination at national level. So, partnerships are essential, no stakeholder can do this alone.
- One important outcome of this conference could be the establishment of partnerships and a common platform to exchange lessons learned on business models that work.

1. Introduction

Hybrid potato breeding has become a realistic approach over the past decade and is seen by many as an important innovation that may affect both potato breeding and cultivation in the context of global challenges such as food security, agrobiodiversity and climate change. The emergence of this innovation was the subject of a project *Responsible innovation in Dutch potato breeding* ('Potarei' for short) from 2015 to 2020, funded by the Dutch Research Council NWO. The project was initiated by researchers from Wageningen University, the Rathenau Instituut and the University of Groningen, with the active participation of the Dutch potato breeding company Solynta. The project focused on conditions for a responsible development of hybrid potato breeding, taking into account 'the productivity, sustainability and diversity of current potato production systems' (Responsible innovation in Dutch potato breeding | NWO-MVI (nwo-mvi.nl)).

Today, more than five years after the start of the project, various companies (including Solynta, Bejo Seeds, HZPC and EASI Seeds) are working on hybrid potato breeding and we are on the eve of the market introduction of hybrid varieties. Against this background, the conference was organized to bring together, compare and contrast insights from breeders, farmers, industry, NGOs and policymakers to assess the possible future of hybrid potatoes in an international context. That future will not only depend on the ultimate agronomic performance of hybrid potatoes, but also on a range of societal conditions that can influence the success of hybrid breeding and cultivation. Accordingly, the conference focused in particular on the *social and system conditions* that could guide the future of hybrid potatoes.

In her opening address *Myrtille Danse, executive director of the Netherlands Food Partnership (NFP)*, put potato breeding and cultivation in the context of the need to strengthen local food systems, especially in response to SDG2 and related challenges of climate change and world population growth. As access to quality seed (tubers or true seed) is key in achieving this aim, the NFP is eager to see how to contribute to a responsible and sustainable introduction of hybrid potato seed in established seed systems.

Jim Lorenzen, senior programme officer of the Bill and Melinda Gates Foundation (BMGF), emphasized in a short introduction to the conference the role of agriculture in poverty reduction, with potato as an important source of food and income for smallholder farmers. However, yields are strongly adversely affected by the rapid spread of pests and diseases, due to degenerated propagation material (tubers) and a too close succession of seasonal cultivation cycles. As major promises of hybrid breeding Lorenzen mentioned faster development of new varieties, greatly reduced risk of spreading pests and diseases, lower seed transport costs, and more easy access to locally adapted varieties through regional breeding networks. For the uptake by farmers however the price should be right!

These introductory remarks preluded two guiding themes informing the programme for this conference, one relating to hybrid breeding, the other to hybrid seed:

- Hybrid breeding as a driver of rapid variety development with added value that may serve food security, sustainability and climate adaptation as important sustainable development goals.
- True potato seed as a driver of changing agricultural practices and business models that may have far-reaching implications for a broad range of stakeholders.

In the plenary morning session, hybrid potato breeding was introduced and discussed as a radical system innovation and different scenarios were presented as possible futures for this innovation. In the afternoon, hybrid potato was discussed in two parallel afternoon programme tracks, focusing on

different potato system contexts. One parallel track focused on the European agro-industrial potato sector, which may lend itself in many ways to the introduction of hybrid potatoes, although it may also have to undergo significant system transformations to enable a successful introduction of this innovation. The other track focused on the international development context of Africa, with its highly informal potato sector dominated by smallholder farmers, where the conditions for hybrid potato cultivation with commercially sourced seed are much more challenging. The conference concluded with a panel discussion on the role of hybrid potato in achieving food security and related sustainable development goals, and ended with closing reflections by Louise Fresco, president of the Executive Board of Wageningen University & Research. The conference programme has been added as an appendix to this report.

The conference was followed online by participants from all over the world, varying in number throughout the day between 150 and 180. Concise summaries of the presentations and discussions during the conference have been included in this report, with text boxes highlighting the key messages from each session. For power points see: Presentations Potato Conference (nlfoodpartnership.com). Some of the major lessons emerging from this conference are discussed in the final conclusions of this report.

2. Morning plenary session

a. Diploid hybrid potato as a system innovation

Key messages:

- Hybrid potato breeding is a system innovation which may affect almost every step in the potato value chain. It can thus be seen as a disruptive and game changing technology, involving and affecting all players in the sector.
- Potato breeding and cultivation will more and more follow the dynamics of the vegetable sector, characterized by the rapid introduction of new varieties, product diversification, higher nutritional value and the introduction of resistant and stress-tolerant cultivars.
- For a further understanding of the impact of hybrid potato, we must distinguish between the value chain in high income and low income countries as different system contexts.

The morning session started with a presentation by *Pim Lindhout, one of the founders and R&D booster of Solynta*, a Dutch breeding company which initiated the development of diploid hybrid breeding in potato. Lindhout discussed hybrid breeding as a system innovation which may affect almost every step in the potato value chain. A hybrid breeding programme starts with the generation of inbred parent lines in a prolonged programme of testing, selection and introgression breeding. Hybrids are the result of crossings between carefully chosen parent lines.[1] Next steps are large scale hybrid seed production, cultivation of seedlings in the greenhouse and finally potato cultivation from planted seedlings in the field. All these steps require new ways of working, unleashing many other innovations along the value chain, including equipment, skills and new seed regulations. In this sense hybrid breeding can be seen as a disruptive and game changing technology, involving and affecting all players in the sector. One key feature of hybrid potato is the acceleration of the process of breeding. While conventional potato breeding may take decennia to develop a new variety, hybrid breeding will need less than 5 years once it can build on a well-characterized genetic library of parent lines. Another key feature is the use of true potato seed that it is easy to store and transport and will greatly reduce the time and area needed to produce seed tubers as starting material for potato cultivation. As Lindhout pointed out, Solynta's seed proposition is just at the start of a progress boom. A 20-40% improvement in yield is realistic. Work on hybrid seed with Phytophthora resistance started in 2015 and double stack resistant hybrids were already tested in the field in 2017. Potato breeding and cultivation will more and more follow the dynamics of the vegetable sector, characterized by the rapid introduction of new varieties, product diversification, higher nutritional value and the introduction of resistant and stress-tolerant cultivars. In addition to the formal agro-industrial seed sector, Solynta also wants to serve the informal seed sector by adapting potato hybrids to the diverse agroecological conditions of smallholder farming. Field trials with hybrid potato in Africa have already shown yields that are significantly higher than the local average. The dream for the future is to breed hybrid varieties adapted to lowland tropical areas. Here long term and large public investments are needed. Lindhout concluded his presentation with a call for an African centre dedicated to collaboration in hybrid breeding for this purpose.

Paul Struik, chairholder Crop Systems Analysis WUR, acted as a commentator in this session. He first of all highlighted the pros and cons of potato as an important staple crop. With its potentially short cycle and with seed tubers as starting material, containing water and nutrients for a quick start and

[1] Solynta's hybrid breeding technology is based on the use of diploid potato varieties in which a wild potato gene has been introduced by means of conventional breeding. This gene allowed the inbreeding of diploid potato which is normally self-incompatible. Thus, by applying repeated self-fertilizations, libraries of homozygous parent lines can be developed to generate diploid hybrid varieties.

high yield, the advantages of potato are clear. It often serves as a hunger-breaking crop or as a short cycle crop between two main crops and can also be a companion crop in intercropping systems. On the other hand, conventional breeding is complex and slow and, as bulky and perishable produce, seed potatoes are difficult to transport and store. Hybrid potato may indeed solve these problems, but may simultaneously nullify some of the agronomic benefits of potato. True seed is less vigorous than tubers as starting material and has a longer growth cycle, thus reducing resource use efficiency and compromising potato as a hunger-breaking crop. For a further understanding of the impact of hybrid potato, Struik distinguished between the value chain in high income and low income countries as different system contexts. Will hybrid potato completely change the value chain in high income countries, or will there be parallel worlds of hybrid and traditional potato cultivation? As uniformity of potatoes is key for industrial purposes, that will be the test for hybrid seed potatoes in the agro-industrial context. Could hybrid potato in low income countries be a push for the development of high added-value production chains? One requirement in this context is that seed governance systems and extension services are able to cope with hybrid potato seed. Even then farmers may not be willing to pay for hybrid seed and stick to saving part of their own tubers as starting material for the next season. In his concluding propositions for debate Struik agreed with Lindhout that for resistance breeding hybrid potato is a game changer. With intensive cropping, hybrid potato will also require a system of specialised growers producing seedlings and seedling tubers as starting material. Only in remote areas with abundant labour and low quality demand, hybrid seed may serve as immediate starting material for potato cultivation.

b. The future of hybrid potato: an agenda for debate

Key messages:

- Hybrid potato seed may play a crucial role in the development of global and regional agri-food systems and consequently may strongly affect potato tuber cultivation and industry in the Netherlands.
- The question how to combine business opportunities for breeders with variety development that serves global food security in sustainable ways is one of the main challenges in hybrid potato innovation.
- One of the most challenging problems in Africa is that farmers often keep inferior tubers as planting material instead of tubers with the highest quality. A successful introduction of hybrid potato will therefore require specialized seed potato growers who can produce and multiply certified potato planting material.

What are the implications of hybrid potato varieties from a broader, global and future-oriented systems perspective? *Rosanne Edelenbosch, senior researcher from the Dutch Rathenau Instituut*, explained in her presentation how this question has been taken up in the 'Potarei' project, mentioned in the introduction. Starting point in this project is the approach of responsible innovation, aiming to involve innovators, societal stakeholders and policy makers in a process of mutual learning about how innovation can respond to major societal challenges like food security and sustainability. In 2016, a first round of interviews with various players in the Dutch potato sector showed a range of different opinions, with both scepticism and high expectations, indicating a high degree of uncertainty about the future of hybrid potato. Based on these interviews and literature review, core questions were identified that could serve as building blocks for an interactive scenario exercise, focusing on the future of hybrid potato in 2040: who will have control over the sector, what will be dominant market trends, what will be important technological trends, and how intensive or extensive will agriculture be at that time? In workshops with stakeholders from the sector three scenarios were elaborated that differed in control over the value chain, consumer demand, technology trends and dominant developments in agriculture. In the *Global duopoly* scenario only two non-European multinationals dominate the complete potato value chain. Potatoes contribute significantly to food security and the bio-economy, but sustainability is not a real concern. In the *Circular and High-tech* scenario circular agriculture is the norm with a high input of technology, including hybrid potatoes, stimulating sustainability but also raising the gap between the global North and global South. In the *Diverse Market* scenario hybrid potato breeding has expanded on the basis of publicly available parent lines, stimulating local breeding initiatives and market diversification on a global scale as a contribution to both food security and sustainability. The question how to combine business opportunities for breeders with variety development that serves global food security in sustainable ways was identified by Edelenbosch as one of the main challenges emerging from this scenario exercise. See for a more detailed account: Rathenau_Instituut_2020_Potatoes_are_the_future.pdf

After this presentation, the participants were given the opportunity to rate both the plausibility and desirability of the three scenarios through an online poll. As can be seen from the table below, opinions about the plausibility of these different futures were fairly evenly distributed among the 151 participants, while opinions about desirability differed more strongly. All in all, the *Global Duopoly* scenario was rejected and the other two scenarios scored similarly, with a slight preference for the *Diverse Markets* scenario.

151 participants	Which future is most plausible?	Which future is most desirable?
Global Duopoly	29 %	1 %
Circular and High-tech	32 %	42 %
Diverse Market	39 %	57 %

Romain Cools, president of the World Potato Congress, was invited in this session to comment on the scenarios presented by Edelenbosch. He argued that future potato cultivation should comply with the requirements of the triple P concept of people, planet and prosperity. Therefore, the *Global Duopoly* scenario calls for a stronger role of the public sector to regulate environmental impacts and to assure food security. Cools also questioned whether this scenario will contribute to prosperity. The *Circular and High-tech* scenario can be seen as a response to the global growth of an urban society, characterized by a gap with the rural world and requiring new connections in food supply. Cools noted as a positive trend that farmers in this scenario become more entrepreneurial and adopt high-tech approaches. As a downside, high-tech forms of agriculture may provoke technology pessimism and resistance, with society questioning agricultural intensification. *Diverse Markets* may be seen as the most realistic scenario, raising questions about the role of patent laws. Cools indeed wondered whether we weren't already moving in the direction of abolishing these laws. Not only because patent laws may be difficult to enforce worldwide (as in China), but also because many NGOs are pushing for free seed multiplication and a wide availability of parent lines. However, as a result, the economic incentive to supply these markets may disappear. The introduction of hybrid potato will thus require new business models, underscoring the game changing character of this technology. Cools concluded that hybrid potato seed may play a crucial role in the development of global and regional agri-food systems and consequently may strongly affect potato tuber cultivation and industry in the Netherlands. The scenario exercise is helpful in thinking about these developments, especially with regard to the role of plant breeders rights and of global actors like CIP and the World Potato Congress.

In the Q&A closing this morning session, doubts were raised as to whether the many qualitative potato traits, controlled by complex genetics, can be made accessible in potato parent lines. Lindhout agreed that this complexity is a big issue in conventional tetraploid breeding, but not in diploid hybrid breeding, where quality traits can more readily be identified, and selected for, in parent lines. Although the traits for tuber size and yield remain challenging indeed. Struik wondered what business model could support Solynta's shift of activities to Africa, where informal seed systems are still dominant. Lindhout emphasized the role of science in Solynta's work, which might change the African sector by showing that the technology works. Nonetheless, to stay in business, Solynta also needs to make money of course. Cools added that there is much fertile land in Africa and a move toward cash crops. Potato processing may be on the horizon and partnerships with the World Potato Congress and the African Potato Association may help to bring hybrid potato to this continent. In response to a question from the audience about the role of CIP in this respect, both Cools and Struik pointed to a range of activities CIP is undertaking in support of potato cultivation in the informal sector. Another question in this context related to the use of farm-saved seeds. As Struik agreed, one of the most challenging problems in Africa is that farmers often keep inferior tubers as planting material instead of tubers with the highest quality. A successful introduction of hybrid potato will therefore require specialized seed potato growers who can produce and multiply certified potato planting material.

3. Afternoon parallel session I

a. Opportunities and threats of hybrid potato for the Dutch agro-industrial potato sector

Key messages:

- The involvement with every aspect of the potato value chain – breeding, cultivation, trade, processing, logistics and technology – makes the Netherlands a vibrant centre in the potato world.
- Hybrid breeding and hybrid potato seed are important innovations for the sector because it may open new markets, especially in regions that are difficult to reach with the export of seed potatoes.
- Although the market potential in Africa is still unclear, high-quality potatoes are crucial to help reach the SDG2 food security goals.
- For Africa, however, we do need business willing to invest in producing true hybrid potato seed, may be as part of corporate social responsibility. Alternatively the public sector could take up the challenge, although it generally has no convincing track-record in seed dissemination.
- It is way too early to predict whether there are opportunities for the Netherlands to become a main exporter of hybrid potato seed, as the final determinant for success is the hybrid potato business model.
- There is no reason to believe that in the international development context the informal seed potato market will disappear through legislation and IP. It will remain highly important for a long time to come.

As *director of the NAO, the Dutch potato branch organization, Dick Hylkema* emphasized the pivotal role of the Netherlands as a potato 'Silicon Valley'. Dutch seed potatoes find their way all over the world and the more than 150 NAO member companies respond to the needs of farmers, processors and consumers with a wide range of varieties. The involvement with every aspect of the potato value chain – breeding, cultivation, trade, processing, logistics and technology – is seen as the secret of this success. These conditions, combined with the support from top knowledge institutions and the Dutch government, makes the Netherlands a vibrant centre in the potato world. Being at the heart of this centre, the NAO is helping its members to stay in the lead and helping other countries to develop their potato sector. According to Hylkema, hybrid breeding and hybrid potato seed are important innovations for the sector to consider because it may open new markets, especially in regions that are difficult to reach with the export of seed potatoes. There is an unlimited need for both seed potatoes and hybrid potato seed as high quality and clean starting material. So, the sector strategy is to add hybrid potato to the product range and to promote sector transformation. It is not yet clear however when and whether hybrid potatoes will match the requirements of highly developed (seed) potato markets in Western Europe, including high yield, uniformity (especially for processing) and increasing sustainability requirements. In Africa with its developing potato markets, there may be demand from smallholder farmers who are especially in need for resistant varieties. Although the market potential is still unclear, as farmers may buy hybrid seed once and save the tubers as before, high-quality potatoes are crucial to help reach the SDG2 food security goals.

Will hybrid potato breeding deliver its promise? *Niels Louwaars, director of the Dutch breeders organization Plantum*, observed that various potato breeders are already working at diploid level and experimenting with new hybrid strategies, involving both the sharing of knowledge and healthy competition. However, the final determinant for success is the business model for hybrid breeding. The trouble is that, for hybrid potato seed, a reliable business model is not so easy to achieve, as intellectual property rights are not protected everywhere and (hybrid) potato is easily propagated

vegetatively. For global food security, potato needs a boost in yield and hybrid seed provision could definitely lead to genetically improved and healthier potato starting material. According to Louwaars, in developing countries, early adopters of hybrid seed may not be traditional potato growers, but growers coming from horticulture, who are used to working with true seeds. What we first of all need however is business willing to invest in producing true hybrid potato seed, may be as part of their corporate social responsibility. Alternatively the public sector could take up the challenge, although it generally has no convincing track-record in seed dissemination. It is way too early to predict whether there are opportunities for the Netherlands to become a main exporter of hybrid potato seed. Therefore, the focus should be on the opportunities in breeding and on research into the potential of hybrid seed in feeding this world.

Shouldn't we expect that the large informal potato sector, based on farm-saved seed, will transform into a formal sector with a huge commercial market for true potato seed? In his response to this question from the audience, Louwaars saw no reason to believe that the informal seed potato market will disappear through legislation and IP. It will remain highly important for a long time to come, especially in tropical Africa and Asia.

One of the issues emphasized in the break-out sessions following these presentations was the importance of communication with the users of hybrid potato seed about the traits they need. Participatory breeding was mentioned as a good way to involve farmers in variety development, also offering interesting opportunities to Dutch breeders for market development. Regulation and market approval of new hybrid varieties in Europe and worldwide were mentioned as another important issue, which was further addressed as a main topic in the next round table discussion. A final point brought up was the dilemma that might result from the rise of hybrid breeding for medium sized firms: how to maintain a position in conventional breeding while simultaneously finding the means for taking up this new innovation?

b. Implications for (inter)national policy and regulation: round table discussion

Key messages:

- Although current regulations are designed for seed potato tubers, no legislative hurdles are to be expected when hybrid seed will enter the market, only requiring minor adjustments of the current international UPOV regime for the protection of new varieties of plants.
- There is much to win by strengthening informal seed systems and making regulation more inclusive, rather than just reinforcing established UPOV rules.
- We need to engage farmers in participatory plant breeding, especially in cases where public breeding is marginal and breeding companies are not interested in the informal market segment.

Marien Valstar, involved in seed policymaking at the Dutch Ministry of Agriculture, opened the discussion with some reflections on the current state of affairs with regard to regulations for seed potatoes and potato seed. He foresaw a hybrid situation, with trade in seed tubers continuing while true seed will find its place. Although current regulations are designed for seed potato tubers, no legislative hurdles are to be expected when hybrid true seed will enter the market, only requiring minor adjustments of the current international UPOV regime for the protection of new varieties of plants. Just like Louwaars in the foregoing session, Valstar further argued that, for the competitive position of the Netherlands in the global seed sector, seed innovation and added value is more important than bulk production.

As seed policy officer with Oxfam, Bram de Jonge brought informal farmer seed systems up for discussion as crucial for our understanding of the impact of hybrid potato seed. While Valstar

considered the role of small farmers in food security an overromanticized idea, de Jonge pointed out that 95% of the seed provision in the world comes from the informal sector. Clean true potato seed may indeed be an opportunity for smallholder farmers, but it will spread mainly through informal channels, as farmers will buy the seed and then multiply and sell seed informally. Thus there is much to win by strengthening informal seed systems and making regulation more inclusive, rather than just reinforcing established UPOV rules. While some countries are more strict in applying UPOV than Europe, others are more flexible. Firms like Solynta likewise may decide not to enforce plant breeders rights in an international development context. De Jonge further emphasized the need to engage farmers in participatory plant breeding, especially in cases where public breeding is marginal and breeding companies are not interested in the informal market segment. Valstar agreed that farmers need more choice in terms of plant genetic diversity, but also emphasized the importance of protecting them against fraudulent seed.

The third participant in this round table was *Hans van der Beek, former agricultural counsellor in the Gulf region*, who referred to the Middle East as a region with a strict seed legislation, thus offering great opportunities to promote and commercialize hybrid potato seed. For van der Beek this seed is a breakthrough that, with a bit of internal lobbying by agricultural counsellors, may get the necessary support from Gulf states. Moreover, compared to seed potato tubers, true potato seed will be a real blessing for the complicated phytosanitary work agricultural counsellors often have to struggle with.

Conference participants had questions about the level of support for hybrid potato from the Dutch government and about the time it would take to pave the way for import to African countries of hybrid seed. Valstar mentioned that in the Netherlands Solynta has been awarded as a 'national icon' for its innovation, which earned them support from the government. The government also supported the sector by establishing a Holland Innovation Potato Platform. However, the time it will take before we will see the first hybrid varieties entering the market does not depend on the government, but on Solynta and other companies. Another question from the audience was about the degree of uniformity to be expected from hybrid true seed, also in relation to the granting of plant breeders rights. According to Valstar a high degree of uniformity may be expected for true potato seeds, in combination with distinctness and stability. De Jonge noted on this point that uniformity is an important concern only for potato processing, and not that important for local markets and consumers. As a final comment Valstar wondered whether the logistic advantage of hybrid true seed might even be more important for its future prospects than its genetic quality.

4. Afternoon parallel session II

a. Challenges and opportunities for the introduction of hybrid potato in an African and international development context

Key messages:

- Potato as a vitally important crop to food security in Africa in the context of rapid population growth and urbanization, but we missed opportunities for increasing yields and farmer income.
- We have to look at innovations as packages, thus asking ourselves what would be the component innovations of a hybrid seed innovation package and how to deal with context specificities and bottlenecks in ways that smallholders can benefit.
- The biggest bottleneck for a widespread scaling of hybrid potato seed is the intermediate infrastructure that you need, including a network of nurseries with the capacity to raise plantlets from seeds, and competent producers of first generation tubers.

- Dialogue and collaboration, involving the whole sector 'diamond', is crucial to see how to make innovation fit and to create both 'push' and 'pull'.
- A working system of plant variety protection is a crucial condition for seed companies to become active in countries and introduce high value varieties.
- Seed certification is important for producers, but often will be too expensive for farmers to afford.

This session started with a presentation by *Graham Thiele, Director of the CGIAR Research Programme on Roots, Tubers and Bananas*, who discussed potato as a vitally important crop to food security in Africa in the context of rapid population growth and urbanization. A major bottleneck in this regard is the low productivity of potato cropping in Africa, with climate change exacerbating the challenges for agri-food systems. In response to these challenges new potato varieties have been introduced, but adoption has been limited due to underinvestment in breeding, an informal system with farmers saving and sharing their own seed, specific and diverse agroecological conditions, and local market taste and colour preferences. Thus we are facing missed opportunities for increasing yields and farmer income! What would it take, in the context of these African system conditions, for a widespread scaling of hybrid potato seed with the prospect of accelerated varietal turnover and yield gain? A single innovation will not scale on its own and we have to look at innovations as packages. We thus must ask ourselves what would be the component innovations of a hybrid seed innovation package and how to deal with context specificities and bottlenecks in ways that smallholders can benefit? In terms of agronomic system conditions, it involves the validation of hybrid seed for local growing conditions, protocols for potato plant raising, and the modification of farmer cultivation practices. In terms of institutional system conditions, there is a need for capacity building and farmer outreach, regulatory procedures for certifying hybrid seed, pro-poor credit arrangements, and market linkages creating stable revenue streams. In this context, Thiele pointed out two potential bottlenecks. One relating to plant raising, implicating a need for specialised hybrid potato seedling raisers who can provide smallholder farmers with first generation tubers. Another relating to local varieties and consumer preferences against which hybrid varieties have to compete, with the option to introduce hybrid varieties first in regions where tubers are relatively expensive and consumers have less marked quality preferences.

In the Q&A session after this presentation, *Mandla Nkomo (Solidaridad)* and *Marja Thijssen (Wageningen Centre for Development Innovation)* had the opportunity to comment. Nkomo responded with the observation that for a potato system transformation you need to operate at multiple levels, requiring interventions both at the policy level and at the ground level. The biggest bottleneck for a widespread scaling of hybrid potato seed is the intermediate infrastructure that you need, including a network of nurseries with the capacity to raise plantlets from seeds, and competent producers of first generation tubers. By supporting farmers with technical know-how they may become local seed producers and many farmers indeed have already experience with growing hybrid peppers and tomatoes. Thijssen very much agreed that, for successful innovation, you need to look at the entire innovation package. On the one hand there is the technical potential to improve breeding, seed multiplication, transport and storage. On the other hand, you need supportive collaboration, public-private partnerships, investment in extension, a valuable business model, appropriate regulation, etc. To make it happen, it is important to have a good understanding of the sector in the country where you want to introduce seed innovation and to be aware of the different interests involved. Dialogue and collaboration, involving the whole sector 'diamond', is crucial to see how to make innovation fit and to create both 'push' and 'pull'.

It was noted by the audience that CIP made large investments in true potato seed (TPS) in the 1980's, but that it never caught on. Why then will current efforts in hybrid true seed be successful? According to Thiele there were many reasons why TPS didn't work, but most importantly its quality did not match

seed potatoes. Therefore it was only attractive to farmers in a 'niche' region like Nepal with limited access to seed potatoes. This prompted the question whether CIP would support the scaling of current hybrid true seed technology. With this technology, as Thiele made clear, there is more hope for success and there is indeed interest at CIP in hybrid potato. In response to a question about the use of transplants instead of tubers in cultivating hybrid potato, Nkomo argued that multiplying seed into tubers may further reduce the cost of potato planting material. The question how hybrid seed can best be made available to farmers is still up in the air however. Anyway, in potato production areas, there should be investment in local nurseries that can produce clean planting material from seed. A final question concerned regulatory barriers and governmental support as one of the multiple levels to address in seed innovation. Thijssen emphasized the importance of a working system of plant variety protection as a crucial condition for seed companies to become active in countries and introduce high value varieties. Nkomo explained how Solidaridad in Mozambique has been helping the country to create an enabling seed policy environment by bringing all stakeholders around the table. Noting that seed systems are areas of conflict of interest, Thiele argued that seed certification is important for producers, but often will be too expensive for farmers to afford. You need a system in which seed multipliers receive certified seeds, while loosening up certification requirements for farmers.

b. Key requirements for successful introduction of hybrid potato in Africa: experiences from the ground

Key messages:

- Seeing is believing: we should make farmers understand the added value of hybrid quality seed through mutual learning in farmer field trials.
- It is all important to clearly and timely inform potato farmers about the necessary changes in their farming practices when shifting from seed tubers to hybrid seed.
- Current variety development does not focus on the particular needs of African potato systems and there seems to be little interest from international seed potato industry to invest in African countries.
- Even though farmers will keep to reusing commercially obtained potato planting material, there is plenty of room for market extension because only a very small percentage of farmers nowadays have access to quality seed.

This session started with short pitches by representatives from four international breeding firms: Rien van Bruchem (Area Crop Manager Bejo), Gerard Backx (CEO HZPC), John Makoni (CEO EASI Seeds), and Maaike Groot (Manager Public Affairs East-West Seed). Bejo is a vegetable breeding company, actively studying the possibilities for hybrid potato in Africa. HZPC is a leading potato breeding company with more than a century long history, also testing hybrid potatoes in Africa. EASI Seeds is marketing a wide range of vegetable seeds to African farmers, including hybrid potato seeds. East-West Seed is a family business in tropical vegetables for smallholder farmers, strongly building on Asia experiences and now also active in Africa.

The four speakers had been asked to discuss (1) key challenges the company has to face in working with hybrid (potato) varieties in the African international development context, and (2) their take home message for successful introduction of these varieties, especially with a view to its potential value for smallholder farmers. According to *Rien van Bruchem from Bejo*, key challenges are: getting permits for the import of hybrid potato seed, national procedures for variety registration, and the breaching of variety protection by farmers multiplying seed tubers that have been grown from hybrid seed. As a take home message van Bruchem emphasized the need for farmer trainings and mutual

learning through farmer field trials, with Bejo acting as a partner. *Gerard Backx from HZPC* mentioned the production, pricing and distribution of hybrid potato planting material as key challenges and also noted that it will take years before hybrid varieties will outperform classic varieties, although early and mediocre hybrid varieties may already compete with local seed potato in Africa. For *John Makoni from EASI Seeds*, the raising and transplanting of hybrid potato seedlings, education of smallholder farmers about early crop management, and finding market outlets for ware potatoes are the main challenges with the introduction of hybrid seed. As a take home message he emphasized the efforts needed to clearly and timely inform potato farmers about the necessary changes in their farming practices when shifting from seed tubers to hybrid true seed. Finally, *Maaike Groot from East-West Seed* mentioned as key challenges concerns about the costs of growing hybrids and confusion among farmers about the distinction between hybrids and GMOs. Her take home message: seeing is believing, thus making farmers understand the added value of hybrid 'quality seed'.

Peter Gildemacher (Head Knowledge Unit KIT Royal Tropical Institute) was invited in this session to comment. He started with two observations. Currently, variety development does not focus on the particular needs of African potato systems. And there seems to be little interest from the international seed potato industry to invest in African countries, while there is a low premium for small producers in Africa to specialize in seed potato production. Two questions followed from these observations with regard to hybrid potato. Its introduction offers opportunities for rapid variety turnover, but will this also lead to more targeted breeding for sub-Saharan Africa? And what about the necessary investments in hybrid seed production? Is there a viable business model for local specialized production and retail of mini-tubers, when farmers can also choose to reproduce these tubers themselves for new cropping seasons? A final question raised by Gildemacher related to the advisory services for farmers as part of the hybrid potato innovation package. Would indeed the market promise of this innovation be attractive enough to really invest in these services?

Questions from the audience primarily related to the business model for hybrid potato in the African context. What will be the economic potential in Africa of the value chain from transplants to ware potato? Van Bruchem admitted that a focus on cost pricing is all important, but was also confident that Bejo would be able to offer seed at a price in the range of tomato and pepper. Backx however questioned whether the potato market really would be willing to pay such prices as the first alternative is the vegetative reproduction of those varieties. Groot, on the other hand, argued that the only way to sell commercial seeds in smallholder settings is to make farmers see the added value, which will take a long-time effort indeed. In addition, she noted that investment in quality seeds represents only 10% of the investment in farm inputs like chemicals and water, inputs which will yield much less without investing in seeds too. Gildemacher added to this point that, even though farmers will keep to reusing commercially obtained potato planting material, there is plenty of room for market extension because only a very small percentage of farmers nowadays have access to quality seed.

5. Afternoon plenary session

a. Panel discussion

Key messages:

- Without denying the importance of plant breeders rights, research done with public funds should reflect the public good of affordable planting material.
- The interface between formal and informal seed systems requires flexible regulation, novel methods for access to seed and attention for the role of women as seed potato producers.

- Hybrid breeding offers the opportunity to focus on traits specifically needed in Africa, also enabling potato cultivation in new environments and warmer climate zones.

A panel with Mandla Nkomo, Jim Lorenzen, Graham Thiele, Niels Louwaars and Peter Gildemacher finally discussed the role of hybrid potato in achieving food security, sustainability and social justice as important sustainable development goals.

According to Nkomo the priority is to improve access to good planting material, especially with its 'last mile' distribution. The challenge is to make distribution of hybrid potato seed more effective than the current system of tuber distribution with all its logistic challenges. His second point was about affordability. Without denying the importance of plant breeders rights, Nkomo maintained that research done with public funds should reflect the public good of affordable planting material. The price of hybrid seed is not yet known, but he hoped that a 'high volume low price' approach will lead to equitable access, thus contributing to SDG2. In response, Louwaars recalled the Kenyan slogan "good seed costs nothing, it pays", whereby transport costs of hybrid true seed do not make the difference, but the research efforts that add value to the seed.

As Thiele pointed out, the 'last mile' is also about inclusion of smallholder farmers and their preferences, whereby the informal seed system will continue to be important with the introduction of hybrid true potato seed. The interface between formal and informal seed systems requires flexible regulation, novel methods for access to seed and attention for the role of women as seed potato producers, also making seed systems more resilient to shocks like Covid19 and climate events. Gildemacher mentioned local multiplication as another important issue in this context. With the introduction of hybrid potato seed, the major system change is that new possibilities arise for local multiplication, making available to end users either plantlets or tubers as starting material. As there are not many large farmers in sub-Saharan potato regions, multiplication ideally should be scale neutral, not requiring much land and offering business opportunities for both youth and women. As soon as competitive varieties are available, it will be possible to test business models linking breeders with local multipliers.

Wondering where the first adoption of hybrid seed will happen, Louwaars suggested that it may not be in traditional higher altitude areas, but at middle and lower altitude, where disease pressure is higher. Thiele agreed that there is a need to breed potatoes for a warmer climate, also enabling potato cultivation in new environments. More in general, Gildemacher emphasized the opportunity to focus hybrid breeding on traits specifically needed in Africa, as these are different from Asia and Europe. As it may not be the first priority for business, that is where public-private partnership like Seed NL should come in.

b. Closing reflections by Louise Fresco

Key messages:

- Undernutrition requires food that is affordable for the urban poor while offering income for the rural poor. This is only possible with an efficient organization of the food chain as a whole.
- The introduction of hybrid seed requires an integrated chain approach and coordination at national level. So, partnerships are essential, no stakeholder can do this alone.
- One important outcome of this conference could be the establishment of partnerships and a common platform to exchange lessons learned on business models that work.

The question how hybrid potato can contribute to SDG2 and its dimensions of poverty and undernutrition was also taken as a starting point by *Louise O. Fresco, president of the Executive Board of Wageningen University & Research*, in her closing reflections on the conference. The botanical structure of potatoes and tubers allows for high productivity. Yet, farmers in Africa and beyond still struggle with a big yield gap. When introducing hybrids with the aim to reduce this gap, we also need to address the production system as a whole. Can we have a system that allows smallholder farmers to grow into emerging entrepreneurs with potatoes as a base crop? Undernutrition requires food that is affordable for the urban poor while offering income for the rural poor. This is only possible with an efficient organization of the food chain as a whole. The challenge is to help farmers realize the potential of potatoes. Thus, breeding goals should also respond to the diversity of cropping systems. As there is no blueprint miracle potato that fits everywhere, hybrid breeding as a new approach can help diversify the seed system for the variation in conditions. A crucial issue from the economic point of view is how to breed potatoes that fit both small and large scale producers. Overall, the introduction of hybrid seed requires an integrated chain approach and coordination at national level. So, partnerships are essential, no stakeholder can do this alone. Looking forward to the longer term, potatoes may serve many uses in the biobased economy and also play a role in replacing animal proteins. This modern uses need to translate into new breeding goals for the long term. One important outcome of this conference could be the establishment of partnerships and a common platform to exchange lessons learned on business models that work.

The final point in Fresco's reflections was also emphasized by Netherlands Food Partnership director Myrtille Danse in her thanks to the organizers of the conference, with the announcement of a follow-up meeting to build the agenda for next actions.

6. Concluding observations

In this concluding section we would like to reflect from the perspective of responsible innovation on a number of themes that emerged during the conference: the game changing character of hybrid potato seed technology, the relationship between formal and informal potato systems, the challenge to develop business models for hybrid potato, and the relationship between public and private interests.

Game changing technology

Hybrid potato seed technology is indeed a game changing technology with the potential to contribute to food security and prosperity. The production of potatoes per hectare, especially in developing countries can increase significantly and the technology may lower disease pressure by means of resistant varieties. The work of Potarei PhD Luuk van Dijk and co-workers shows that hybrid potato cultivation may result in different cropping and cultivation systems, varying from direct sowing in open ground to special nurseries that produce seed-based transplants or seedling tubers.[2] Hybrid breeding may therefore have disruptive consequences. Some speakers expect that hybrid potato breeding technology may even turn potato cultivation into a kind of horticulture with short variety cycles.[3] This game-changing dimension of hybrid potatoes implies that we can better talk of a system transition, involving an extensive innovation package, as was also observed during the conference. The work of Potarei researcher Rosanne Edelenbosch and her colleagues indicates that on a global scale

[2] van Dijk LCM, Lommen WJM, de Vries ME, Kacheyo OC, Struik PC (2020) Hilling of transplanted seedlings from novel hybrid true potato seeds does not enhance tuber yield but can affect tuber size distribution. Potato Res https://doi.org/10.1007/s11540-020-09481-x

3 This is also mentioned in the discussion section of the paper: Van Dijk LCM, Kacheyo OC, De Vries ME, Lommen WJM & Struik PC, 2021. Crop cycle length determines optimal transplant moment for seedlings from hybrid true potato seeds.

agricultural sectors may change completely in 10 or 20 years and that, within the global potato sector, hybrid technology may have an important role in that.[4] To understand such a fundamental transformation, we need a comprehensive systems perspective, as countless other innovations – in a technical, social, economic, environmental and institutional sense – must take place to make it successful and, not in the least, acceptable, as an example of responsible innovation.

Formal and informal systems

This brings us to a second theme: the impact of hybrid potato technology, or rather innovation package, on informal agricultural systems in low-income countries. In these countries, where the majority of the population belongs to small farmers and where often women have a significant role in agriculture, this impact can be far reaching because agricultural systems are directly linked to social and cultural patterns and structures on a local level. Several speakers indicated that these informal systems will not disappear. If the hybrid potato, which is strongly coupled to western-based formal agronomic systems, is to be successful in these areas, modes will have to be found that enable coexistence with these informal systems. Knowledge of and respect for these local systems and the willingness of Western actors to critically reflect on dominant approaches and ideas that are prevailing in the West, was also stressed as an important pre-condition for responsible innovation by African participants in a Potarei workshop on hybrid breeding in 2019 in Ghent.[5] In this context, hybrid potato has the potential to contribute to a mutually beneficial interface between formal and informal systems, because the so-called farmer's privilege in the plant breeders' rights model allows farmers to use tubers of hybrid potato varieties as seed potatoes in an informal system. It is expected that farmers will also trade these tubers at their local markets and thus contribute to the dispersion of the new hybrid varieties in these regions.

Business models

The introduction of hybrid potatoes may also lead to new business models as this technology makes it possible to breed specific varieties at a much higher speed. It can lead to the expansion of existing markets, but also to new markets, processing activities, and industries. It can, however, also generate skepticism and resistance when it conflicts with existing agronomic traditions, interests and potato value systems.[6] In general, business models for hybrid crops are often based on the fact that the crops are not suitable for propagation by farmers themselves. In this regard, the potato is a problematic crop because tubers of hybrid varieties can still be propagated in the traditional way. It could mean that business models for hybrid potatoes will stronger rely on variety protection regimes such as breeders rights and patent laws, which in turn could be a source of controversies. Developing business models is especially difficult in low-income countries, as the new varieties are likely to be introduced at premium prices, which will not be affordable for most farmers. This implies that the introduction will only take place through a limited number of wealthier farmers or institutional parties. However, as explained before, because of the farmer's privilege, new varieties are expected to trickle down in the informal system and propagated vegetatively anyway. It is not inconceivable that the accumulation of diseases in these tubers over a number of propagation cycles will create a growing demand for clean tubers or plantlets of these varieties. The formal commercial hybrid system may thus function as a continuous input source that can provide disease-free tubers to the informal system and contribute to higher yields and fewer diseases overall.

[4] Edelenbosch R & Munich G (2020) *Potatoes are the future – Three scenarios for hybrid potatoes and the global food supply*. The Hague: Rathenau Instituut (https://www.rathenau.nl/sites/default/files/2020-12/Rathenau_Instituut_2020_Potatoes_are_the_future.pdf)

[5] Swart JAA. Swart & Stemerding D (2019) Opportunities and challenges for hybrid potatoes in East Africa. Available at https://www.nlfoodpartnership.com.

[6] Beumer K, Edelenbosch R (2019) Hybrid potato breeding: A framework for mapping contested socio- technical futures. Futures, https://doi.org/10.1016/j.futures.2019.01.004

Private and public interests

Another theme is the relationship between public and private partners. It was noted during the conference that a lot of breeding research is funded with public money and that new technologies should therefore be sufficiently publicly available. Indeed, much knowledge on breeding and starting material comes from public sectors and may be considered as a common or a public good.[7] However, private companies also add value and distribution efficiency to these public goods. The interdependency of the public and private sectors implies a need for cooperation and sharing of seeds and knowledge. The problem, of course, is that recognition of the partly public character of breeding knowledge does not directly lead to a working business model for seed companies that have to operate individually in a globally organized competitive system, from which they cannot easily withdraw. In that regard, the outcome of the poll held during the conference on the desirability and plausibility of the three scenarios was striking. Of the more than 150 participants in the poll, nearly 30 percent thought that further global monopolization was plausible, but only one percent believed that such a future was desirable. The poll thus suggests a large gap between what is desired and what is expected to happen. This points to the risk of a development that no one wants but that will nevertheless happen.

Towards a sector-based corporate social responsibility

Based on the themes described above we observe a number of challenges:

1) The extent to which the Dutch sector can maintain leadership in the seed potato market versus the rise of regionally and locally oriented markets in the context of hybrid potato breeding.
2) The extent to which business models can be developed that result in a synergistic connection between the formal Western potato system and the informal systems in low-income countries.
3) The extent to which potato breeding companies are able to develop varieties and business models that respond to the needs and circumstances of local farming in low-income countries.
4) The extent to which potato breeders are able to develop and introduce varieties (as an innovation package) that will make a substantial contribution to SDG goals.

These challenges require both particular breeding efforts, institutional changes and measures that strengthen the position of weaker stakeholders in the potato value chain, especially in low-income countries. It also requires reflection on the position and role of the Dutch potato sector as a strong and significant actor. And it stresses the need to take serious the concept of corporate social responsibility, which refers to the internalization of norms and values by the company, related to social and sustainability goals inside and outside the company. As such it is linked to the Triple-P concept (People, Planet, and Prosperity) as well as to SDG dimensions.

However, these challenges are huge and probably transcend the capacities of individual companies that, as stated, have to operate in a global and highly competitive environment. What is needed is a collective effort at the international sector level to put CSR values into practice.[8] In other words, CSR should be conceived as a commons-based practice that benefits everyone only if it is adopted collectively. Individual companies can, however, still play a role in responding to these challenges. Indeed, although breeding companies are highly competitive, there is in this sector a long tradition of cooperation and exchange of knowledge, supported by governmental and sector-wide institutions, especially in the Netherlands. It is precisely this tradition that has the potential to institutionalize corporate social responsibility on the sector level in an international context, in order to give

[7] Beumer K, Stemerding D. & Swart JAA (2020) Innovation and the commons: lessons from the governance of genetic resources in potato breeding. Agriculture and Human Values. https://doi.org/10.1007/s10460-020-10169-8

[8] See also Netherlands Food Platform (2021) Vision document. Available at https://www.nlfoodpartnership.com.

stakeholders a significant voice at multiple levels over the value chain. It should lead, as was argued during the conference, to an integrated chain approach, requiring the support from supranational institutions, international funding organizations, charities and companies. Aiming at a sector-based corporate social responsibility approach, we would like to suggest the following steps and conditions:

- Research and experiments are needed to assess the potential, impact and consequences of hybrid potato seed technology. Not only with respect to diverse agronomic aspects but also to cultural and wider system aspects, including SDG2 goals that may be served directly or indirectly by this technology. With such programmes, including pilots and sector development projects, one is better equipped to anticipate the consequences of the introduction of hybrid potato.
- Such programmes should not be undertaken without participation of affected stakeholders themselves. Participation, however, should not be limited to explaining the technology and its benefits, it should also address the needs, concerns and objections of the stakeholder communities involved and the solutions they favor.
- Technology should not be seen as a morally neutral instrument as it may represent hidden value systems of innovating companies. Because of its game changing and possibly disruptive nature, it may also affect value systems of stakeholder communities. Respect for such value systems and the willingness to expose one's own value system to criticism, should be part of sector-based corporate social responsibility.
- It is important to constitute sector-based corporate social responsibility on a collective commons-based level, including mechanisms that should prevent individual companies from circumventing jointly agreed CSR objectives.

These considerations should be translated and elaborated in concrete measures, actions, and practices. Extension activities, cooperation with local stakeholders, participatory breeding and sharing of knowledge are possible elaborations. However, it should also be accepted that these considerations may lead to abandoning a particular intended development or technology because of insufficient support from stakeholder communities addressed.

Appendix 1

Conference programme Potato futures: impact of hybrid varieties		
	Topics	**Speakers**
10.00	**1. Welcome and Introduction** Aims, structure and background of the conference SDG2 and related sustainable development goals as normative perspective	
10.10	**Opening by Jim Lorenzen** (Senior Programme Officer - Bill and Melinda Gates Foundation)	
10.30	**2.a Diploid hybrid potato as a system innovation**	
10.30 – 10.40	Main aims, technicalities and current achievements with emphasis to breeding, seed production, agronomy and logistics	Pim Lindhout (founder Solynta)
10.40 – 11.00	Game changer? Hybrid potato as a system innovation in diverse agricultural systems: propositions for discussion	Paul Struik (Crop Systems Analysis - WUR)
11.00	**2.b The future of hybrid potato: an agenda for debate**	
11.00 – 11.20	Expectations, potential innovation dynamics, future trends, uncertainties and scenarios from a societal point of view	Rosanne Edelenbosch (Rathenau Instituut)
11.30 – 11.45	Plausibility, feasibility and desirability of the three scenarios – reflections on the outcomes of the poll	Romain Cools (president of World Potato Congress) – International Speaker
11.45 – 12.30	Q&A with Pim Lindhout, Paul Struik, Rosanne Edelenbosch, Romain Cools – *Q&A session in Studio*	
Prospects and challenges in a Dutch and agro-industrial system context *(parallel session 1)*		
13.30	**3.a Opportunities and threats of hybrid potato for the Dutch agro-industrial potato sector**	
13.30 – 13.45	• Impacts of hybrid potato on the relations between value chain actors and business models • Impacts on the international position of the Dutch (seed) potato sector – with a view on SDG2 and related sustainable development goals	Dick Hylkema (Director - NAO)
13.45 – 14.00	Main opportunities and threats for breeding and cultivation – next steps	Niels Louwaars (Managing Director Plantum)
14.00 - 14.20	*Discussion in four break-out groups: what actions are needed?*	
14.20 – 14.30	*Sub- plenary feedback on outcomes break-out groups : moderators report back on key actions*	
14.45	**3.b Implications for (inter)national policy and regulation: round table discussion**	

14.45-15.15	Round table talk/conversation around: ● Policy issues, phytosanitary and regulatory challenges emerging with hybrid potato ● Institutional and policy constraints in the global distribution of seed tubers and of true potato seeds ● Challenges with international policy and regulation in the local/informal context ● An enabling environment: role of Dutch Embassies in international positioning of the Dutch Potato sector	Participants: Marien Valstar (Seeds and Plant Propagation Material, Ministry of Agriculture) Bram de Jonge (Seed Policy Officer Oxfam) Hans van der Beek (Former Agricultural Counsellor)
15.15 – 15.30	Q&A: how to create an enabling environment for hybrid potato?	
Prospects and challenges in an international development context *(parallel session 2)*		
13.30	**4.a Challenges and opportunities for the introduction of hybrid potato in an African and international development context**	
13.30-13:45	Transition from current potato (seed) systems to hybrid potato systems: system requirements and implications for food security	Graham Thiele (Director CGIAR Programme on RTB)
13.45-14.30	Q&A session: ● The need for high quality starting material for potato in South-Africa ● How to support strategic innovation pathways to close the seed gap	Mandla Nkomo (Solidaridad) Marja Thijssen (Wageningen Centre for Development Innovation)
14.45	**4.b Key requirements for successful introduction of hybrid potato in Africa: experiences from the ground**	
14.45-15.50	Sharing experiences and lessons learned	Rien van Bruchem (Bejo)
15.50-15.55		Gerard Backx (HZPC)
14.55-15.00		John Makoni, CEO of EASI Seed (Zimbabwe)
15.00-15.05		Maaike Groot, East West Seeds
15.10-15.20	Reflection: Key issues and concerns with regard to hybrid potato systems and value chains	Peter Gildemacher (Head of Sustainable Economic Development and Gender -KIT)
15.20-15.30	*Q&A*	
Final panel discussion and closing reflections		
16.00	What is the role for hybrid potato in achieving SDG2 and related sustainable development goals?	Panellists from sector, science, breeders, policy makers and NGOs.
16.45	Closing reflections	Louise O. Fresco (President of the Executive Board of Wageningen University & Research Executive Board)

17.00	Word of thanks	Myrtille Danse (Netherlands Food Partnership)